# Energy Efficient Measures in Barracks

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# Agenda

- Building Envelope
  - Roofing
  - Wall Insulation
  - Window Film and Shading
- Dehumidification – Case Study
- Separate Ventilation and A/C System
- Demand-Side Management
  - Lighting
    - Compact Fluorescents and T-5/8 Lamps
    - Occupancy Sensors
  - Occupancy Control Systems
  - Carbon-dioxide ($CO_2$) sensors
- LEED Credits
- Building Commissioning
- Preventive Maintenance
- Energy Star Appliances
- On-Site PV, other renewables

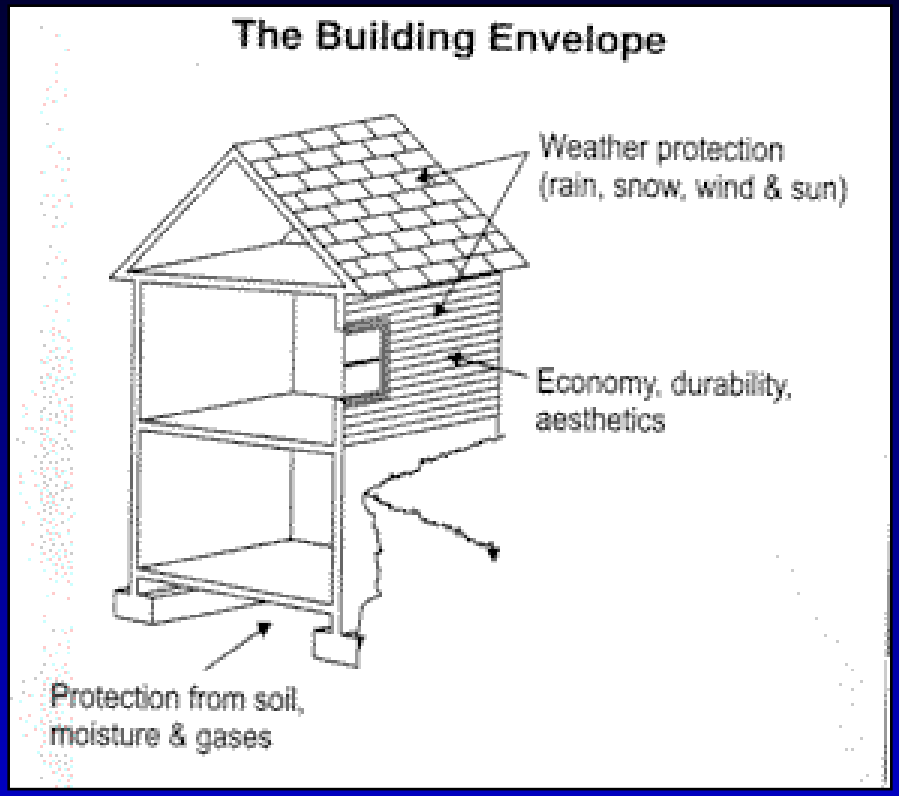
# Introduction

- Buildings are complex systems and influenced by:
  - Building envelope
  - Heating and cooling equipment
  - Appliances
- Energy consumption is influenced by:
  - Interaction of all the elements list
  - External factors
    - Climate and orientation
    - Construction of building
    - Behaviour of the users of buildings

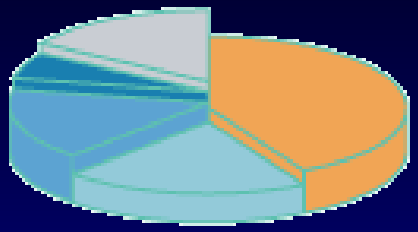
**Therefore, we need a multi-faceted approach tackling existing buildings and equipment, and new construction is to the highest standard and options for the latest technologies**

- Building envelope is obviously an important starting point in reviewing energy use

# Building Envelope

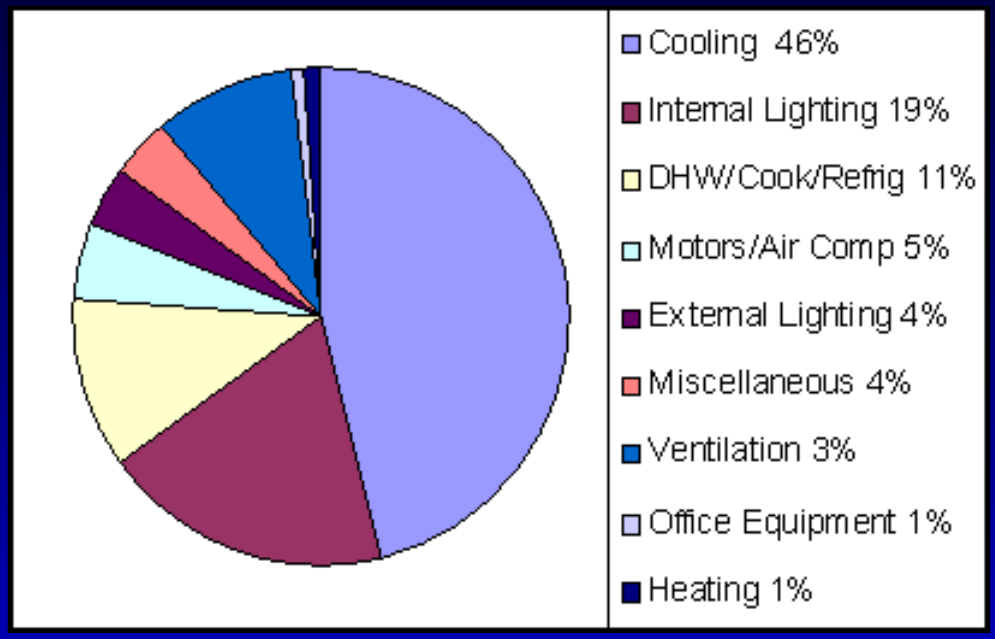


## Lodging: All Zones

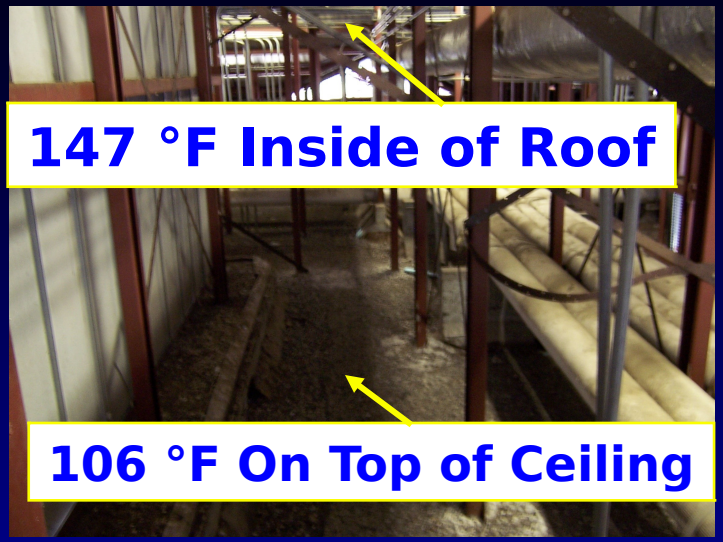


- 42% Water Heating
- 20% Lighting
- 16% Space Heating
- 6% Space Cooling
- 16% Other

## Typical Equipment Usage (% of KWh) Hotel/Motel DOE Climatic Zones 1 and 2



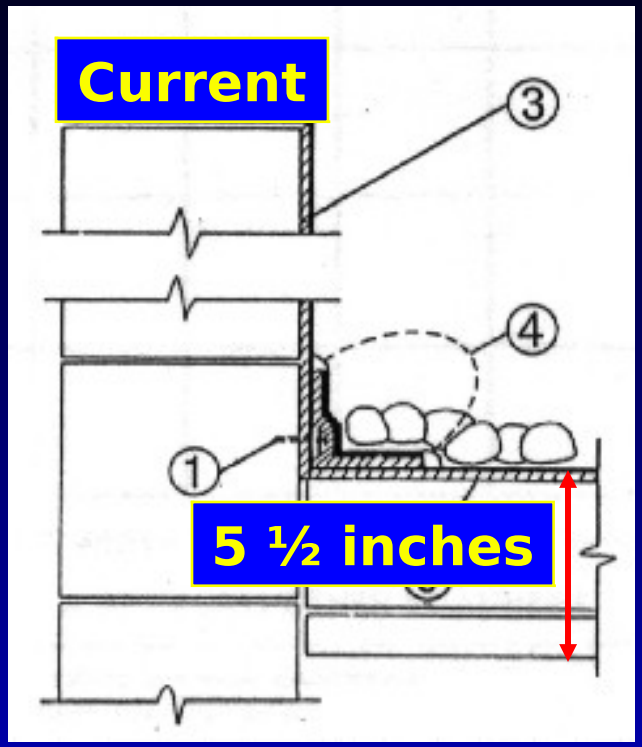
# Roofing Insulation

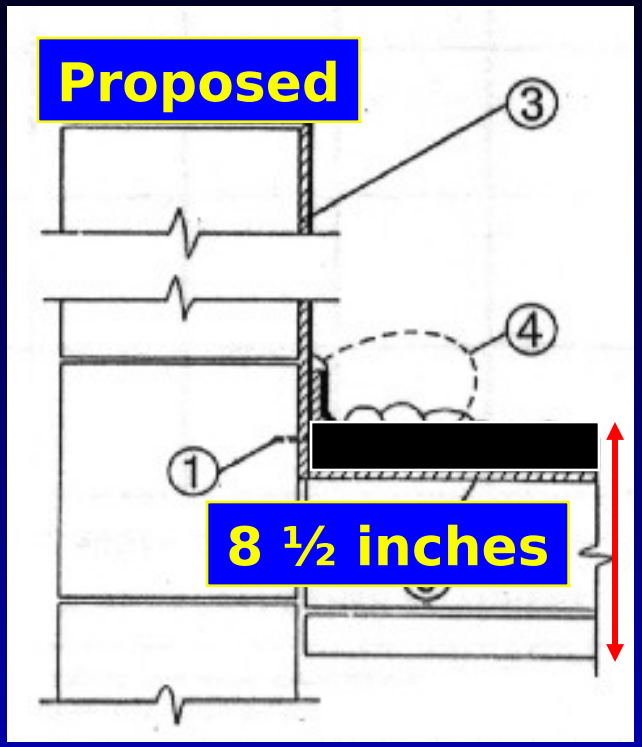



Outside Air Temp = 93 ° F

76 °F On Top of Ceiling, inside room above false ceiling @ 75 °F Room Temp

# Influence of Added Insulation for Re-Roofing




Increase R Value from 19 to 23

Total Roof Area = 410,750 ft²

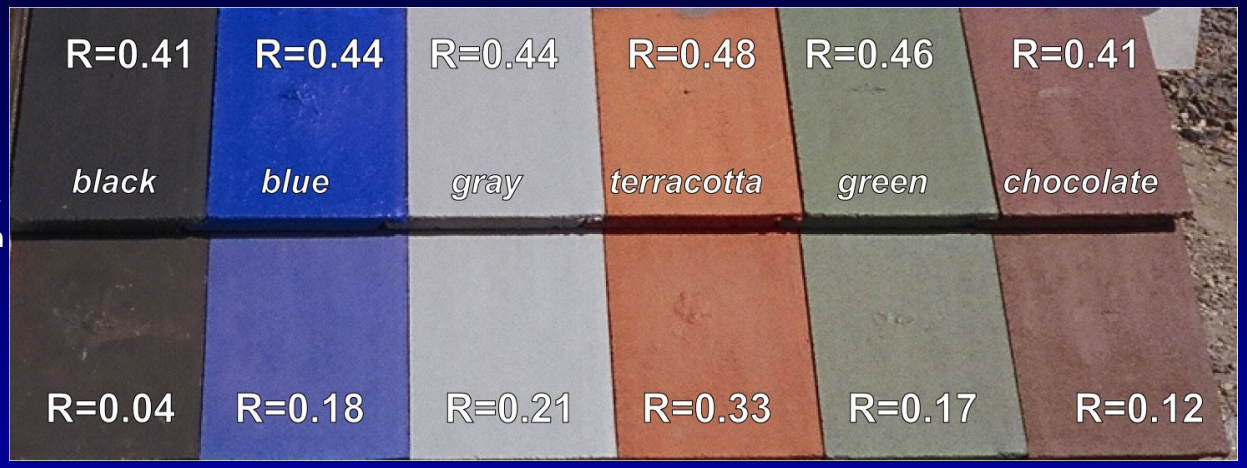
Total Cost = $ 944,725

Total Savings = $27,000

Payback = 35 yrs

# Example: Absorbing Roofs (By Color)

# Example: Cool and Standard Color-Matched Concrete Tiles




Courtesy American Rooftile Coatings

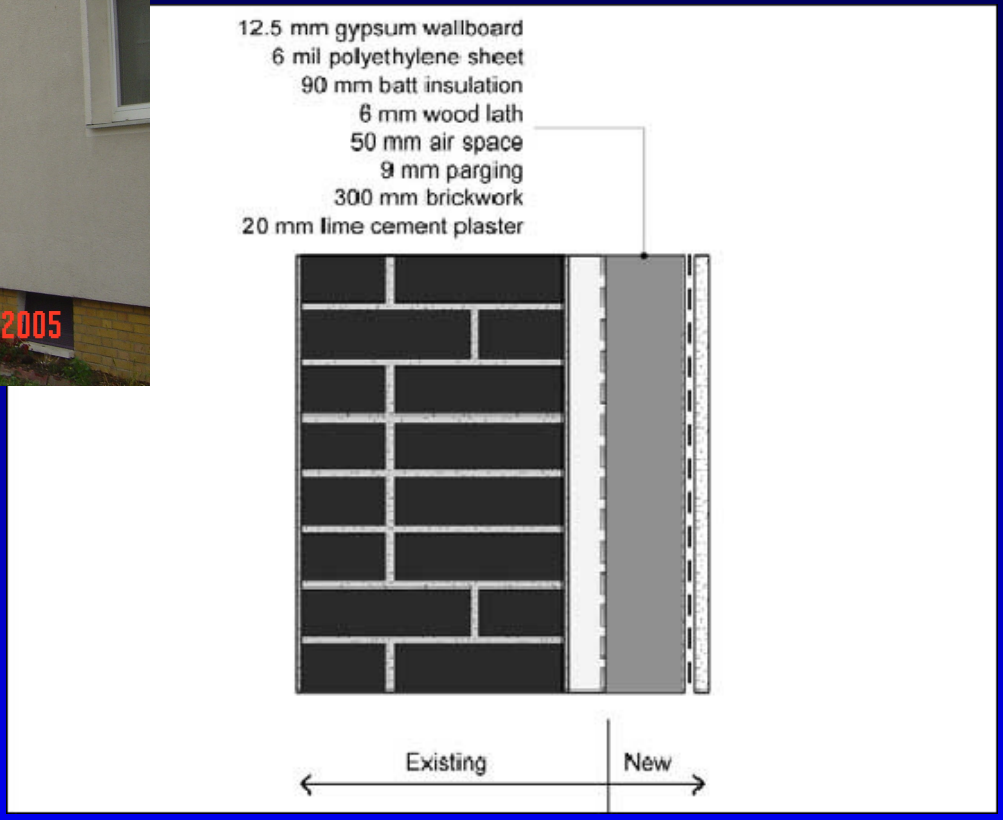
cool

standard

ΔR=0.37 ΔR=0.26 ΔR=0.23 ΔR=0.15 ΔR=0.29 ΔR=0.29

- Can increase solar reflectance by up to 0.5
- Gain greatest for dark colors
- Similar Costs

# Improved Wall Insulation



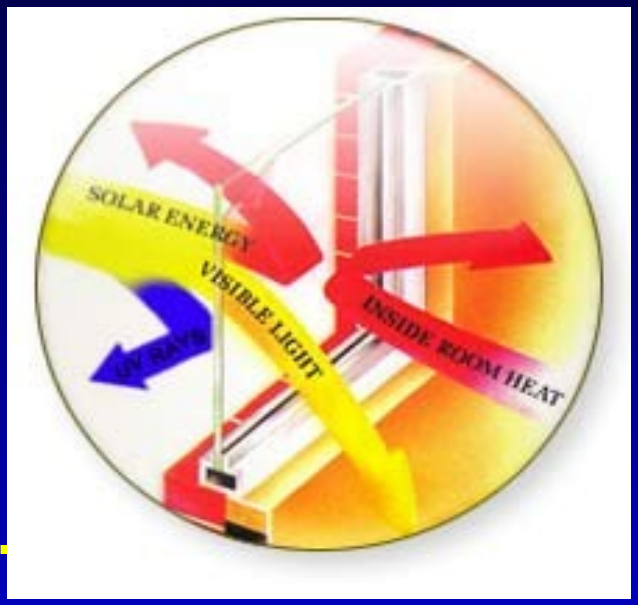
# Window Film

**There are documented cases of film lasting 12 to 22 years or more in some instances.**

**The film ranges from $3 to $12 per square foot. (Material O**

# Window Film

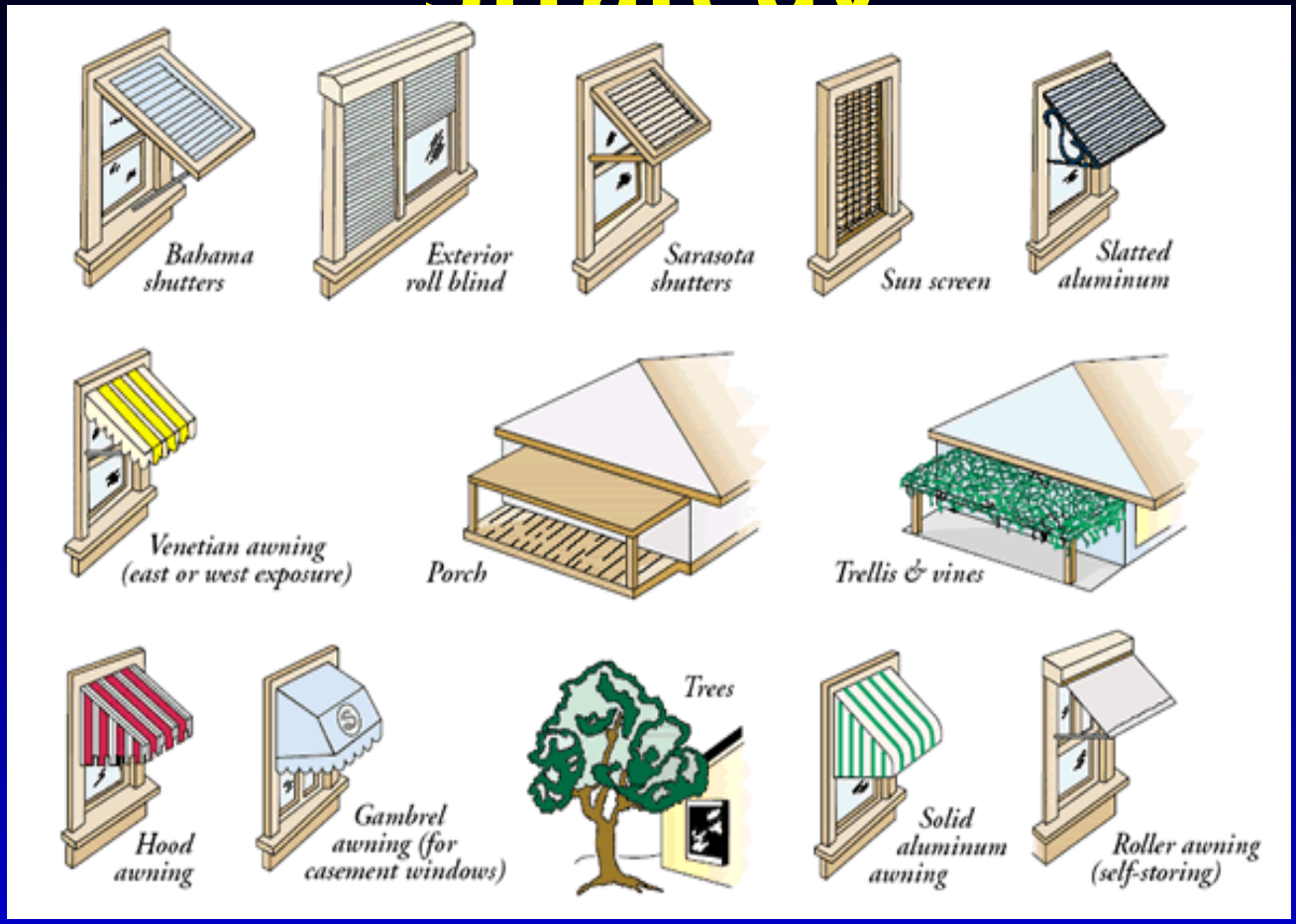
- Up to 99% Ultraviolet (UV) light reduction resulting in:
  - Significant fade protection for furniture, carpet, draperies, wood
  - Reduced fabric/textile deterioration
  - Reduced exposure to UV radiation
- Increased shatter resistance resulting in:
  - Increased peace of mind
  - Increased safety and security
  - Heavy gauge security films offer significant benefits from:
    - Natural disasters such as violent storms, earthquake, high winds, etc.
    - Vandalism
    - Scratching/graffiti (glass tagging) on exterior windows



# Window Film

- Scratch resistant hard coating protects against:
  - Accidental abrasion and product deterioration
  - Hazy appearance typical with plastic type materials
- Performs well in all climates
- Metallized or solar control window film can provide:
  - Significantly reduced solar heat gain resulting in:
    - Increased comfort
    - Reduced air conditioning costs
    - Reduced HVAC equipment wear and tear/maintenance
    - Increased fade resistance
  - Glare reduction
  - Daytime privacy
  - Lower energy demands from utilities resulting in:
    - Lower overall energy costs
    - Decreased demand for new power generating facilities
    - Decreased environmental emissions

# Exterior Window Shading Strategy




***Exterior*** **shades catch the sun and reflect some of it away from the window. Some exterior shades are partially transparent, so some of the incident radiation passes through them to the window. Heat absorbed by the exterior shade is largely carried away from the window by radiation and air convection currents.**

# Window Shades

# Summary of Building Envelope ECM's

- Roofing and Insulation
- Wall Insulation
- Window Shades
- Energy efficient windows. (Can reduce annual HVAC energy costs by up to 15 % if properly installed)
- Add window film to windows. **Films reduce cooling loads, improve shatter resistance, block up to 99 % of ultraviolet radiation, and reduce glare.**
- Consider double/triple paned or low-e windows **According to Florida Power & Light, energy efficient windows can cut annual energy costs by up to 15 %.**
- Evaluate insulation in ceilings and add insulation as needed.
- Consider installing white or reflective roofing (Cool Roofs)
- Replace damaged weather-stripping on doors and windows with caulk.

# General Problems with Humidity in Barracks

# Dehumidification for Barracks Facilities: Findings
# Case Study: Ft. Stewart

- Assume chilled water piping will remain the same:  8 ° F temp rise from CEP to barracks
  - 50 ° F CWS can't dehumidify properly
  - CWS should be 45 ° F or less
- Many rooftop MUA units not operational
- Portable space dehumidifiers require daily emptying and add to room cooling load
- Condensation drips and negative room pressure  lead to mold growth
- At least $1 Million annually for mold cleanup
- Potential man-hours lost due to building related illness (BRI)

# Dehumidification for Barracks Facilities: Solutions

**Install new dedicated outdoor air system (DOAS) to dehumidify supply air to barrack rooms**

**(Jim Newman Presentation)**

- Introduce dryer air than existing MUA units on roof
- Heat recovery provides free reheat
- Minimize need for portable dehumidifier in rooms
- Easier to maintain and more reliable than roof units
- First units will require DX coils and separate condensing units to achieve proper dehumidification
- When CW piping is repaired to achieve 45 ° entering barracks, future units can use CW coils instead of DX

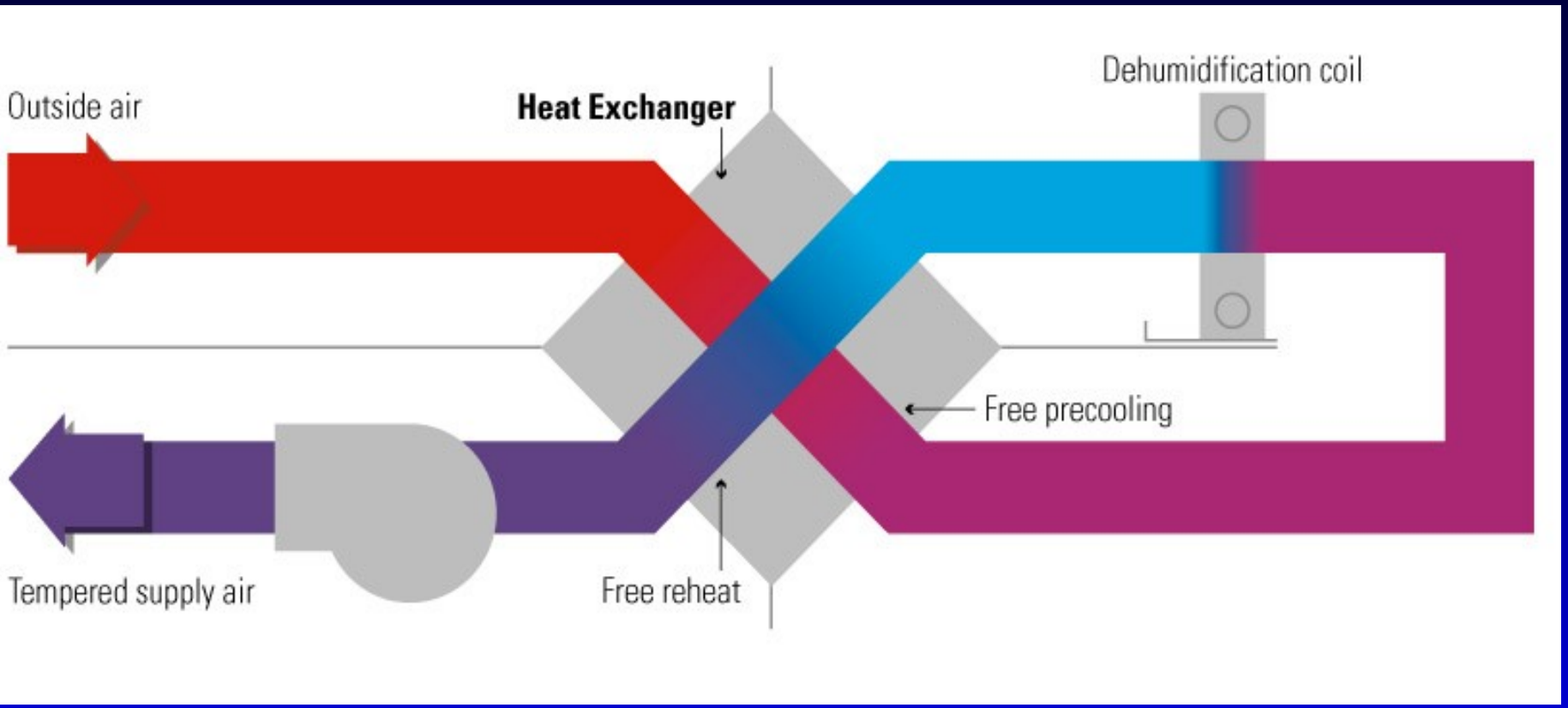
# Outside Air Dehumidification

- Use OADU units to provide humidity control in high ventilation rate applications

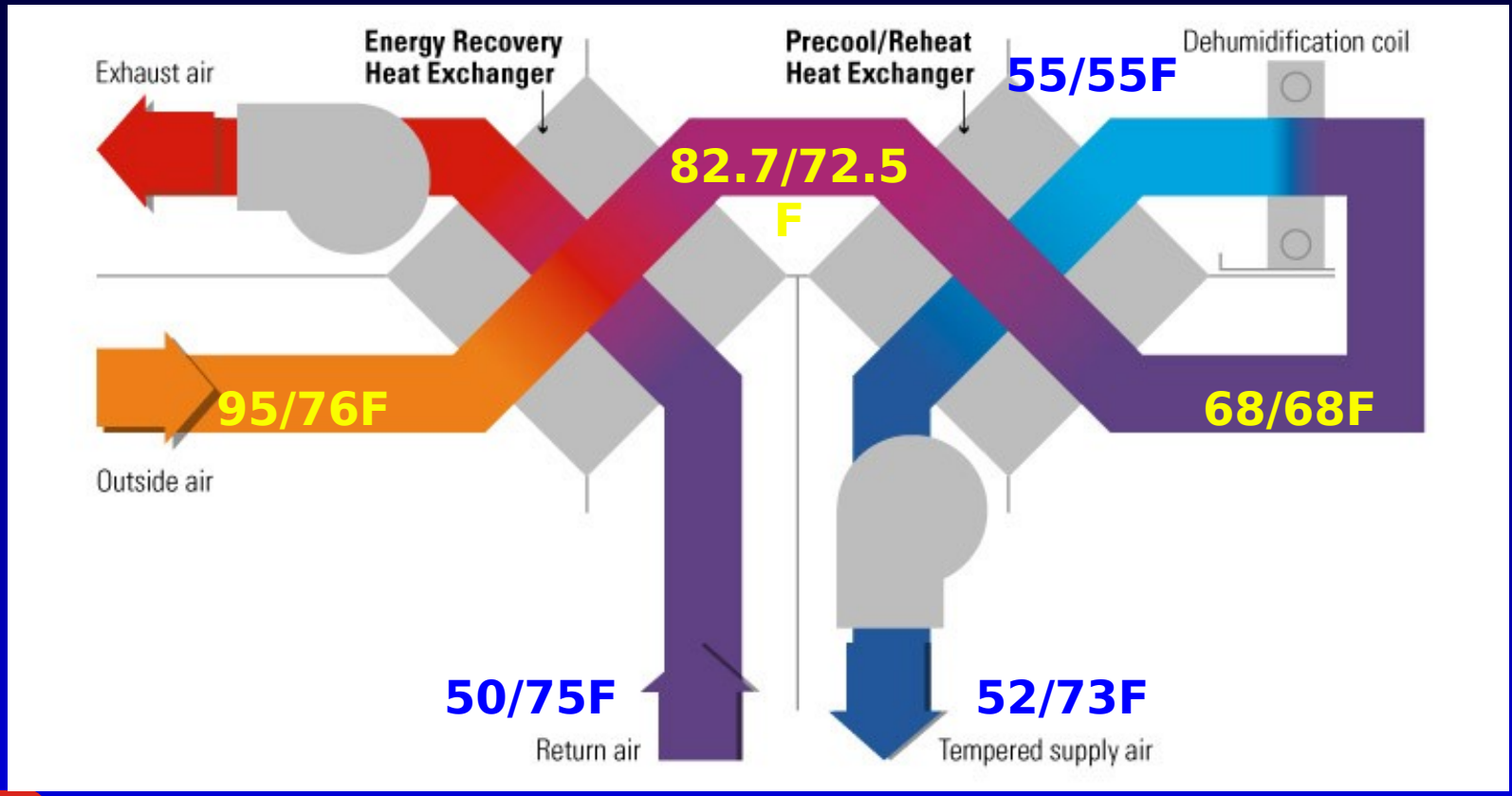
- Dehumidification Only (LASER-1)
  - dehumidifies and tempers summer outside air
  - uses one air-air heat exchanger
  - Is not an air-to-air energy recovery device

- Dehumidification with Energy Recovery (LASER-2)
  - dehumidifies and tempers summer outside air
  - tempers winter O/A
  - uses two air-air heat exchangers
  - performs energy recovery using building exhaust air

# LASER-1 Flow Schematic



# Dehumidification with Energy Recovery



# Dehumidification for Barracks Facilities: Scope, Costs and Savings

- Scope
  - 31 modular barracks
  - 2460 rooms
  - 1,160,000 ft$^2$ conditioned space
- Costs
  - Estimate Total Cost Installed - $2.8 Million
  - Estimate Total Cost Installed - $2.3 Million (if chilled water supply temperature is reduced to 45 °F or less)
- Savings (Energy and Ancillary)
  - $715K
- Payback
  - 3.9 Years

# Other Findings: Supply Air Ducts in Barracks and Mold in Barracks Rooms

Supply Air Grill

Not Changed (Clean Only) During Renovation

1. Mold and Mildew
2. Rust

Clean thoroughly with bleach-type cleaner and paint or replace all grills

Closet: Pre-renovation

1. Dehumidify Air
2. Ensure supply air units operating
3. Blower door tests to ensure room tightness
4. Install insulation on exposed cold piping
5. Clear condensate drain panels
6. Replace wall partitions

# Demand-Side Management

**This includes a wide range of actions to reduce demand for electricity (or gas) and/or to shift demand from peak to off-peak times.**

# Lighting

1. Rewire for zone lighting
2. Eliminate every other light fixture in corridors

# Occupancy – Photo – $CO_2$ Sensors

Occupancy Sensors for Individual Rooms

Photo Sensors for Exterior Lighting

Dayrooms – Laundry Rooms: Using $CO_2$ as an indicator allows ventilation based on actual occupancy while still maintaining ASHRAE recommended per-person ventilation rates. Fresh air may be introduced in a sufficient volume to maintain a healthy breathing environment while keeping energy costs to a minimum.

# No/Low Cost Deployment ECM's

- Use only dedicated outdoor air system for temperature and humidity control
- Raise temp in Summer
- Lower temp in Winter
- Close all shades
- Lighting: Photo Sensors
- Replace damaged weather-stripping on doors and windows with caulk
- PM and Commission HVAC systems

# Summary of Demand-Side ECM's

- Occupancy or $CO_2$ Sensors
- Replace standard incandescent bulbs with compact fluorescents or other high energy efficient lighting
- Use the lowest wattage lamp necessary
- Use energy-saving fluorescent T5 or T8 lamps over old-style T12 lamps
- Consider using natural daylight where possible
- **Solar Water Heaters**
- Utilize light colored walls and ceilings
- Clean bulbs for maximum efficiency
- Use dimmer controls in meeting rooms
- Use occupancy sensors to detect the presence or absence of people and turn lights on and off accordingly
- Use an energy-efficient light-emitting diode (LED) night light to eliminate the need to leave bathroom lights on throughout the night.
- Replace incandescent lamps in exit signs with light-emitting diode exit signs
- Eliminate or reduce external lighting not needed for safety or security
- Utilize light colored walls and ceilings. Light colored walls and ceilings as appropriate increase in light levels by 15% to 50%.

# LEED Credits for Energy Efficient Measures

| Energy & Atmosphere | | 17 Points |
|---|---|---|
| Prereq 1 | Fundamental Commissioning of the Building Energy Systems | Required |
| Prereq 2 | Minimum Energy Performance | Required |
| Prereq 3 | Fundamental Refrigerant Management | Required |
| Credit 1 | Optimize Energy Performance | 1 to 10 |
| Credit 2.1 | On-Site Renewable Energy | 1 to 3 |
| Credit 3 | Enhanced Commissioning | 1 |
| Credit 4 | Enhanced Refrigerant Management | 1 |
| Credit 5 | Measurement & Verification | 1 |
| Credit 6 | Green Power | 1 |

6 points for 30% less than 90.1

# Questions or Comments ?